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AUTHOR	Berry, Michael A.
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ABSTRACT

Asserting that successfully managing a school environment is a necessary and essential educational investment, this paper details common problems with school environments and how to address them. These include environmental awareness training, moisture and water management, effective ventilation, mold removal, and cleaning and restoration effectiveness. The paper also discusses components of an environmental management process for continuous improvement in a school environment, including appointing an indoor environmental quality (IEQ) coordinator, identifying priority projects, identifying and using IEQ consultants as necessary, and management review. (Contains a list of 23 Web site resources.) (EV)

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Managing School Environments

By

Michael A. Berry

Dr. Michael A. Berry is a Research Professor at the University of North Carolina at Chapel Hill where he teaches and writes on business and environment, built environments, and environmental management systems. His is currently focusing his research in the area of school environments. Dr. Berry retired from the US Environmental Protection Agency in 1998 where as a senior manager and scientist he served as the Deputy Director of National Center for Environmental Assessment at Research Triangle Park, NC. Between 1985 and 1994 he served as EPA's manager for indoor air research. Visit his website www.DrMABerry.com or contact him at DrMABerry@aol.com.

Schools are special environments that exist for the purpose of enhancing the learning process. They are built environments that house sensitive segments of the population. In the United States there are about 120,000 schools, providing for the educational needs of approximately 54 million students. On average, students receive about 20% of their environmental exposure in schools.

The importance of a healthy school environment to enhance the learning process has been demonstrated in many studies; however, many school facilities throughout the United States, estimated at more than 50%, have environmental problems. Even though schools are the focus of constant public debate and discussion, more effort is needed to provide "healthy" school facilities.

Successfully managing a school environment is a necessary and essential educational investment. There is a clear link between environmental quality of schools and educational performance:

- Management systems determine environmental quality in schools
- The quality of the school environment shapes attitudes of students, teachers and staff
- Attitudes affect teaching and learning behavior
- Behavior affects performance
- Educational performance determines future outcomes of individuals and society as a whole

Previous studies have shown that cleaning, maintenance and restoration, when consistently implemented, are cost effective and can lead to measurable environmental improvements. For example, an EPA sponsored study, "The Total Building Cleaning Effectiveness

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Study," (attached) conducted by RTI in collaboration with the professional cleaning industry, clearly demonstrated that an organized EMS program contributes to reductions in particles, volatile organic compounds (VOCs), and biological pollutants in excess of 50-90%.

The primary environmental policy of every school should be that of taking whatever steps are necessary to create a "sense of well-being." By definition, this is a healthy environment. " Health is the state of complete physical, mental, and social well-being."

Healthy schools have some obvious traits.

- The school seeks and provides adequate space and an opportunity to spread out, communicate, think, and interact.
- The outside appearance of the school is inviting.
- The school is designed for good lighting. The school has adequate natural lighting that enhances productivity.
- The school strives for student friendly conditions.
- The school wants an environment that is inviting to good teachers.
- The school strives to send a caring message and reduce stress.
- The school wants occupant comfort, consistent climate/temperature.
- The school wants a clean and sanitary environment.
- The school works at providing ever-challenging traffic control and parking.

A school environment should be one in which no additional strain is placed on the students and teachers other than that needed to help the students learn. Student and teacher comfort is probably the most important aspect of any school environment. If students are comfortable, then learning becomes much easier. Being comfortable is a combination of several different factors.

First of all is the classroom. It is most important because it is where students and teachers spend most of their time and where the learning process takes place. The following is a list of criteria that will help make the classroom a better place to learn.

- Lighting in classrooms should focus on the chalkboard or front of the classroom and over the student's desks.
- Temperature is also important. A temperature of 68-72 degrees should be maintained year round.
- Walls of the classrooms should be insulated to keep noise levels down.
- Schools should also be designed to accommodate students so that the number of students does not exceed 20. A lower density of students per classroom will increase teacher/student interaction.

The cleanliness of schools is also an important aspect of school environments. Sanitation is very important. Clean schools not only lower the threat of the spread of illness, but also convey a caring message to the students. The design of schools is a very important factor when dealing with sanitation. Building roofs that will not hold water and leak is essential. Water in classrooms leads to mold, which can cause allergies. High humidity also creates an environment favorable to all kinds of bacteria, which can spread diseases. Indoor air quality is also and important factor. Schools must be designed with good ventilation to keep particulate matter, such as dust, out of the air. Odors can also be distractions to students, but can be taken care of with good ventilation. Upkeep and maintenance of schools is very important. Students feel better going to clean classes and sitting in clean desks.

Classrooms should be designed with communication and interaction in mind. Students should be able to easily see and communicate with the instructor and with each other. Technology also aids in communication. Computers in classrooms are very important. Tools such as the Internet allow information to be exchanged with ease; and students can learn through virtual classrooms when no teacher is available.

A school environment should be one in which every student feels safe. We find the promotion of safety by the increased installation of cameras and monitoring devices throughout the school. Many schools today work with local law enforcement agencies to put police officers in schools. The presence of police in schools gives students a sense of safety and security.

Many things can be done to help the school environment operate more efficiently. Training programs should be in place for the workers on how the buildings operate and how to do their jobs more efficiently. There should also be pay incentives for teachers if certain goals are met and higher pay in general.

The location of schools is also very important. Schools should be located close to large areas of population to keep transportation time down and maximize time spent in the classroom. Schools should also be located in areas that are visibly pleasing to the students. Trees and greenery help to enhance the image of the school for students. Schools should also try and create a sense of tradition and pride. This will further encourage students, teachers and staff.

There are many environmental requirements that all schools face. These include numerous fire safety codes, provisions for handicap occupants, and numerous state and federal environmental statutes. *However, the driving force behind managing a school environment*

is not regulatory. It is the local community's expectation of a healthy school environment, free of biopollutants and other detrimental health effects.

Most school environment problems center on the need for environmental awareness training, moisture and water management, effective ventilation, mold removal and cleaning and restoration effectiveness. If these problems remain uncorrected, complaints can be expected to intensify, and the school will incur additional remediation costs. If the "immediate challenges" are not corrected, they will interfere with the educational process and end up costing the community excessive sums of tax dollars in the long run.

Understanding School Building Dynamics

There needs to be widespread awareness of how the school building functions. The lack of awareness is creating poor environmental conditions inside the majority of school buildings. A training process should start to inform students, faculty and general personnel about some technical issues behind the perception of school environment. For example, the building as a shelter-designed to keep the outside environment out, the nature and role of HVAC systems and the effect that negative and positive pressure has on indoor pollution levels.

Prevent Moisture Intrusions

Moisture in schools is the main cause of structural damage and health risks.

In order to effectively keep water from leaking into a building, the roof must be structurally sound and in good repair. All leaks must be repaired. To mitigate future costs and leaks, a simple low gradient structure above the current roof should be installed. This will channel water off the roof.

Drainage systems must work. Drainage systems must divert water from the building. The schools immediately assess the drainage system, improve current drainage system and maintenance of drains and install a drain system for the buildings as well as guttering where they currently do not exist but are necessary.

Repair Mechanical and Ventilation Systems

HVAC aids in the regulation of moisture mitigation and the circulation of outside air. The schools should assess HVAC system performance and repair and maintain current HVAC systems regularly.

A ventilation system is necessary to maintain a dry environment. Biopollutants (primarily bacteria and fungi) depend upon the availability of moisture and an organic food supply in order to survive and grow. A relative humidity of 70% or higher will lead to a moisture level best suited for microbial growth. In order to prevent this phenomenon, water must be

managed. A moisture problem in any indoor environment requires immediate action to be taken. In order to quickly and effectively dry out the environment, ventilation (natural and mechanical) must be utilized to create an air flow. During the summer, air conditioners may be used as a ventilation source. Also, dehumidifiers should be brought in during periods of high humidity or if the area is unresponsive to the ventilation system.

Establish a Structured Mold Remediation Program

If mold is not removed properly, the spores will become airborne and spread throughout the building causing health problems. The school should establish a training program for safe removal of mold spores in the building.

Concern about indoor exposure to mold has been increasing as the public becomes aware that exposure to mold can cause a variety of health effects and symptoms, including allergic reactions.

Molds can be found almost anywhere; they can grow on virtually any organic substance, as long as moisture and oxygen are present. There are molds that can grow on wood, paper, carpet, foods, and insulation. When excessive moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or is not addressed. It is impossible to eliminate all mold and mold spores in the indoor environment. However, mold growth can be controlled indoors by controlling moisture indoors.

Molds reproduce by making spores that can usually be seen without magnification. Mold spores waft through the indoor and outdoor air continually. When mold spores land on a damp spot indoors, they begin growing and digesting whatever they are growing on in order to survive. Molds gradually destroy the things on which they grow. Prevent damage to building materials and furnishings, save money, and avoid potential health risks by controlling moisture and eliminating mold growth.

Many types of molds exist. All molds have the potential to affect health. Molds can produce allergens that can trigger allergic reactions or even asthma attacks in people allergic to mold. Others are known to produce potent toxins and/or irritants. Potential health concerns are important reasons to prevent mold growth and to clean up any existing indoor mold growth.

Since mold requires water to grow, it is important to prevent moisture problems in buildings. Moisture problems can have many causes, including uncontrolled humidity. Some moisture problems in buildings have been linked to changes in building construction practices during the 1970s, 80s, and 90s. Some of these changes have resulted in buildings that are tightly sealed but lack adequate ventilation, potentially leading to moisture

buildup. Building materials, such as drywall, may not allow moisture to escape easily. Moisture problems may include roof leaks, landscaping or gutters that direct water into or under the building, and unvented combustion appliances. Delayed maintenance or insufficient maintenance are also associated with moisture problems in schools and large buildings. Moisture problems in portable classrooms and other temporary structures have frequently been associated with mold problems.

When mold growth occurs in buildings, some building occupants, particularly those with allergies or respiratory problems, may report adverse health problems. Remediators should avoid exposing themselves and others to mold-laden dusts as they conduct their cleanup activities. Caution should be used to prevent mold and mold spores from being dispersed throughout the air where they can be inhaled by building occupants. The key to mold control is moisture control. Solve moisture problems before they become mold problems. The following are tips to use in mold prevention:

- Fix leaky plumbing and leaks in the building envelope as soon as possible.
- Watch for condensation and wet spots. Fix source(s) of moisture problem(s) as soon as possible.
- Prevent moisture due to condensation by increasing surface temperature or reducing the moisture level in air (humidity). To increase surface temperature, insulate or increase air circulation. To reduce the moisture level in air, repair leaks, increase ventilation (if outside air is cold and dry), or dehumidify (if outdoor air is warm and humid).
- Keep heating, ventilation, and air conditioning (HVAC) lines and drip pans clean, flowing properly, and unobstructed.
- Vent moisture-generating appliances, such as dryers, to the outside where possible.
- Maintain low indoor humidity, below 60% relative humidity (RH), ideally 30-50%, if possible.
- Perform regular building/HVAC inspections and maintenance as scheduled.
- Clean and dry wet or damp spots within 48 hours.
- Do not let foundations stay wet. Provide drainage and slope the ground away from the foundation.

An environmental coordinator should set up a mold remediation program for the school, rather than just mold removal. Sometimes just removing a mold source can cause more damage than leaving it in the environment because movement of the source causes spores to infect the indoor air. The process for mold remediation should be explained to the custodial staff and utilized. The environmental manager should also oversee all mold remediation.

Follow this recommend checklist for mold remediation:

- ❑ Investigate and evaluate moisture and mold problems
- ❑ Assess size of moldy area (square feet)
- ❑ Consider the possibility of hidden mold
- ❑ Clean up small mold problems and fix moisture problems before they become large problems
- ❑ Select remediation manager for medium or large size mold problem
- ❑ Investigate areas associated with occupant complaints
- ❑ Identify source(s) or cause of water or moisture problem(s)
- ❑ Note type of water-damaged materials (wallboard, carpet, etc.)
- ❑ Check inside air ducts and air handling unit
- ❑ Throughout process, consult qualified professionals, if necessary or desired
- ❑ Communicate with building occupants at all stages of process, as appropriate
- ❑ Designate contact person for questions and comments about medium or large scale remediation as needed
- ❑ Plan remediation
- ❑ Adapt or modify remediation guidelines to fit your situation; use professional judgment
- ❑ Plan to dry wet, non-moldy materials within 48 hours to prevent mold growth
- ❑ Select cleanup methods for moldy items
- ❑ Select personal protection equipment - protect remediators
- ❑ Select containment equipment - protect building occupants
- ❑ Select remediation personnel who have the experience and training needed to implement the remediation plan and use personal protection equipment and containment as appropriate
- ❑ Remediate moisture and mold problems
- ❑ Fix moisture problem, implement repair plan and/or maintenance plan
- ❑ Dry wet, non-moldy materials within 48 hours to prevent mold growth
- ❑ Clean and dry moldy materials
- ❑ Discard moldy porous items that cannot be cleaned

{Note: As moldy materials dry, they release spores. Strive to remove wet moldy materials before they dry.}

Emphasize a Cleaning Effectiveness Program

Cleaning is the most effective means of achieving a high level of environment quality in a school. The school should establish a cleaning training program for the custodial staff. It is recommended that the school promote the inclusion of incentive programs with empowerment focus. Develop cleaning programs that capture and remove dust and other particles rather than just push them around. Purchase new and effective cleaning equipment.

One of the biggest problems that needs attention in every school is the janitorial closet. Known as the "nerve center" of the environment, this room needs to be properly maintained. Once the janitor's closet is organized, the janitorial staff needs to be taught the purpose of each supply and trained to properly use the product for its intended purpose. After this initial teaching, the janitors should maintain the closet.

The importance of cleaning on the part of principals, school system managers is necessary in order to have an effective school cleaning program. There must be a source and system of motivation and accountability. One must train the leaders in the school system so that they can recognize effective and ineffective cleaning procedures. Knowledgeable leaders will result in more effective cleaning procedures.

The head custodian must not only be trained to clean effectively, but he or she must be instructed to provide the training program for incoming staff. This "certification" will enable the head custodian to be in a leadership position and perform regular checks on the custodial staff and their performance. The person in this position should also be paid the maximum amount available so that they will be increasingly reliable.

The custodians must be trained to clean effectively and efficiently. By instructing them on proper use of cleaning materials, proper techniques, etc, the building will become a much healthier environment.

The supplies and custodians' closets each need to be examined for their effectiveness and cleanliness. With regular inspections, the entire school building will benefit. The head custodian should be responsible for these inspections.

The best available technology and supplies should be provided. With effective cleaning equipment and an effective cleaning program that emphasizes the correct use of this equipment, human exposure to biopollutants and microorganisms can be greatly reduced. Only then may an environment be created that reduces the amount of adverse health effects while also promoting better educational performance. There has been serious attention drawn to the type of cleaning equipment used in schools. Because a majority of school environments are carpeted to some extent, proper equipment must be available to clean it. It is a proven fact that vacuuming removes 90 to 95% of all dry soil with a routine cleaning schedule and an effective vacuum cleaner. A proper vacuum cleaner will also allow for an improved physical appearance of the carpet.

When choosing a vacuum cleaner, look for durability in order to reduce long-term costs associated with maintenance or replacement of a less superior product. Air filtration is another important consideration when choosing a vacuum. A vacuum with high airflow is most effective, but if dust and other particulates are allowed to pass directly through the

vacuum, then high air flow becomes irrelevant to the removal of particles. Instead of being extracted from the environment, these particles then become air borne, placing them right back into the environment. Effective vacuums utilize disposable bags. To ensure a clean environment, replacing the bag before it becomes achieves the most efficient system for soil removal. Along with good airflow, a vacuum should offer adjustable, rotating brushes that allow for better soil removal.

The assurance of effective cleaning and good air quality will be obtained with a vacuum bearing an IAQ "Green" Label. A list of vacuums that meet the conditions previously stated may be obtained from the CRI website.

A cleaning effectiveness program should include the following:

- Doormats as particles barriers
- High efficacy extraction cleaning equipment (vacuum cleaners)
- Hot water extraction of carpet
- Damp mopping of surfaces
- Reduced VOC emissions of Products

An environmental management process for continuous improvement in a school environment should include the following:

Appoint an IEQ coordinator

The position of Environmental Coordinator should be created within the school system. Though there would be many duties included, some of these duties would fall into the realm of assuring cleaning effectiveness. This manager would be responsible for organizing the EM program, identifying and correcting problems, auditing and reporting on conditions and training of the staff, while also providing the major source of accountability. Scheduled audits on the school buildings in the system would make each individual custodian feel more individual responsibility.

Identify priority projects

Keep the environment clean
Keep water out of the building: repair the roofs and correct drainage
Keep the indoor environment dry: repair and balance the HVAC system
Respond professionally to water damage situations
Water damage remediation: repair water damage and remove any mold

Identify and use IEQ consultants as necessary

Mechanical engineer
Industrial hygienists
Roof specialist

Evaluate findings

Management review

Report on existing conditions
Recommendation and action plans
Identify management objectivities and priorities

A system of monitoring environmental conditions and measuring progressive improvements needs to be established. The most useful tool for monitoring environmental conditions and bring about improved conditions is an **Environmental Quality Complaint or Request Form.** Among other things, the form will allow the school to manage health complaints and leak reports.

The complaint forms are to be retained; a decreasing rate of complaints indicates improved environmental conditions, since the problems being dealt with cause sickness and allergic reactions.

Considering that indoor moisture is the root of many of the challenges being faced, monitoring actual water content in the air is a good way to know how much progress has been achieved. Leaks should be reported and the document retained on file not only to ensure that the problem is addressed, but also as a quantifiable measure of improvement. As the number of leaks reported falls, the level of environmental conditions should rise.

Other measuring activities could include sampling moisture in materials (paper, walls, and ceilings) and debris levels on a regular basis to monitor changes. However, some form of monitoring is essential to ensure that the plan is in fact producing *measurable* changes in the building. If results are not seen in the reduction of health and leak complaints, and the indoor air moisture levels do not fall, steps will obviously have to be taken to remedy some aspect of the plan. The only reliable way to know if change is really happening is through using quantifiable monitoring techniques such as those mentioned above.

All procedures, complaints and corrective actions should be maintained through standardized documentation to ensure they can be located, periodically reviewed and modified. Documentation should be created for all operations and activities associated with the identified significant environmental aspects in order to identify impacts, track maintenance and improvement and ensure communication with all stakeholders.

In addition to the emergency response systems already in place for fires, natural disasters, etc., schools should be encouraged to design and implement an emergency preparedness and response system to manage leaks, mold, and other water damage. This system should include the following items:

1) Immediate response to health complaints that may be due to water damage
2) Implementing a system of identification and restoration of water damaged areas
3) Implementing a complaint form for environmental matters
4) Effective and immediate (within 24-48 hours) removal of mold. Remove materials when they are wet, not after they dry.
5) Effective training of staff (custodians, etc.) to implement the above strategies
6) Proper equipment for removal of water and mold
7) If immediate removal of mold is not possible, school officials, should remove students from the affected area, similar to any other disaster, until removal occurs.

Responding to Water Damage. Ceilings, walls, floors etc. should be inspected for water damage and properly corrected or restored by staff trained to do so in an environmentally sound manner, preventing even greater hazards. In some cases, replacement may be necessary instead of restoration.

Responding to Health Complaints. Communication of problems is key to avoiding a crisis situation. We need a program that will provide information to schools regarding why children are missing school, and if there are any health complaints about the school environment. This would allow correlations and connections to be made to the school environment if need be. There is concern over privacy. But health complaints to the school about the state of its environment should be taken seriously and documented, not only from students, but also from all faculty and staff. The staff should complete constant monitoring and measurement of hazards such as leaks, moisture levels, dust levels and allergen levels. The custodial staff must be adequately trained and equipped to do the required tasks to preserve a healthy environment.

Responding to Severe Weather. Wind and water damage to the school due totornados or hurricanes are safety matters already covered by safety and evacuation plans. After severe rain, staff should check for standing water on roof and any other retention areas. To reduce risk, it is advised to emphasize the maintenance of equipment and importance of effective communication and to periodically practice the safety/evacuation plan.

EMS audit — Periodically verify that the EMS is operating as intended.
The audit is a systematic and documented verification that the program for continuous improvement is working. It is recommended that an audit be conducted twice a year current problems are corrected (before the school year begins and at Winter break). An

audit should be conducted of the report forms and their effectiveness, corrective actions, and training programs.

Management review — Periodically review EMS with an eye to continual improvement.

The management review is intended to provide a forum for discussion and improvement of the EMS and provide management with a means for making changes and establishing new goals. It is recommended that a management review take place as soon as possible after each of the audits discussed above. Each management review should examine the following:

- The suitability of the EM program
- Action items from previous management reviews
- The adequacy of the objectives
- Budgets and expenditures
- Status of preventive and corrective actions
- Results of audits
- Training programs and sessions
- Numbers of complaints
- Clear statement of goals and priorities and commitment of management support

Websites
School Environments

http://www.epa.gov/iaq

This is the EPA's page on indoor air quality. They have a link for schools, including the Tools for schools.

http://www.iaqa.com

http://www.hsnet.org/internet.htm

http://www.hsnet.org

http://www.epa.gov/ordntrnt/ORD/WebPubs/exposure/indes.html

http://www.epa.gov/children/info/epa_pub.htm

http://www.epa.gov/children/indicators/index.html

http://www.epa.gov/children/info/live.htm

http://www.epa.gov/children

www.cordis.lu/esprit/src/i3school.htm

www.nea.org/esp/resource/iaq.htm

Sources for School Environments

http://www.nces.gov/pubs2000/20000032.pdf

http://gwis.circ.gwu.edu/~greenu/signed.htm

http://www.ed.gov/databases/ERIC-Dgests/ed356564.htm

http://nces.ed.gov/surveys/ruraled/tables/Condition-Rating

http://nces.ed.gov/surveys/ruraled/tables/Percent-Distribution

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http://nces.ed.gov/surveys/rurales/tables/Age-of-Schools

http://www.esri.com/library/usercomf/proc96/TO450/PAP418/P418.HTM

Additional Sites of interest recently found:

Where Children Learn: Facilities Conditions and Student Test Performance in Milwaukee Public Schools
http://www.cefpi.org/issue/index.htm
Environment Based Education: Creating High Performance Schools and Students
Http://www.neetf.org

New Standards Should Help Students in Noisy Classrooms
Http://www.educationworld.com/a-issues/issues073.shtml

Why Optimal Learning Environments Matter
http://www.edi.msstate.edu/optimalhtml

Exploring the Relationship Between High School Facilities and Achievement of High School Students in Georgia
http://www.coe.uga.edu/sdpi/researcabstracts/pattiayers.html

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